Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (cancelled)

2. (cancelled)

3. (original) A method for controlling partial air pressure in an intake manifold of an engine, such engine having an intake throttle device for controlling a flow of air to the intake manifold, an EGR valve for controlling a flow of exhaust gas from the engine to the intake manifold downstream of the intake throttle, at least one cylinder fed a flow comprising air passing through the throttle to the intake manifold and exhaust products passing through the EGR valve to the intake manifold, both the air through the throttle and the exhaust gas products in the intake manifold passing as a combined flow to the intake manifold and then to the at least one cylinder, such method comprising:

estimating the flow of exhaust gas products passing through the EGR valve to the intake manifold from engine operating parameters;

estimating the air fraction in the estimated flow of exhaust gas products passing through the EGR valve to the intake manifold;

determining the partial pressure of air in the intake manifold from such estimate of the flow of exhaust gas products and such estimate of the air fraction; and,

adjusting the intake throttle device in accordance with a difference between a desired partial pressure of the air in the intake manifold and the determined partial pressure of air in the intake manifold.

4. (cancelled)

5. (original) A method for controlling partial pressure of air in an intake manifold of an engine, such engine having an intake throttle device for controlling a flow of air to the intake manifold, an EGR valve for controlling a flow of exhaust gas from the engine to the intake manifold downstream of the intake throttle, at least one cylinder fed a flow comprising air passing through the throttle to the intake manifold and exhaust products passing through the EGR valve to the intake manifold, both the air through the throttle and the exhaust gas products in the intake manifold being passed as a combined flow to the intake manifold and then to the at least one cylinder, such method comprising:

specifying a dynamic reference model for the desired partial pressure of the air as a function of time; and

controlling the flow through the intake throttle device in accordance with an estimated EGR flow obtained by a dynamic observer and an estimate of partial air fraction in the exhaust gas products to force the estimated partial pressure of air in intake manifold to follow the desired partial pressure of air provided by the reference model.

6. (original) The method recited in claim 3 wherein the partial air fraction is estimated in accordance with intake to exhaust delay and fuel injector to exhaust delay.

7. (cancelled)

8. (cancelled)

9. (original) The method recited in claim 6 wherein the dynamic observer is void of information of engine exhaust temperature.

10. (original) The method recited in claim 6 wherein the dynamic observer is void of information of engine exhaust pressure.

11. (original) The method recited in claim 3 wherein the dynamic observer is

$$\varepsilon(t_{k+1}) = \varepsilon(t_k) + dT\left(-\gamma\varepsilon(t_k) - \gamma\frac{R\hat{T}(t_k)}{V_{IM}}(W_{th}(t_k) - \hat{W}_{cyl}(t_k)) + \gamma^2 p(t_k) \right) \text{where:}$$

^ denotes an estimated value;

t_k is the time of a sample of the parameter;

dT is the period between samples of the parameter;

T, is the temperature in the engine intake manifold;

W_{th} is the mass air flow measured through the engine intake throttle;

W_{cylr} is the total flow into the cylinder of the engine;

V_{IM} is intake manifold volume;

R is the gas constant;

λ is adjusted to provide a desired shape of engine torque response; and

$p = p_{air} + p_{bg}$ (where p_{air} is the total pressure in the intake manifold and p_{bg} is the partial pressure of burnt gas in the intake manifold).

12. (original) A method for controlling partial air pressure in an intake manifold of an engine, such engine having an intake throttle device for controlling a flow of air to the intake manifold, an EGR valve for controlling a flow of exhaust gas from the engine to the intake manifold downstream of the intake throttle, and, at least one cylinder fed a flow comprising air passing through the throttle to the intake manifold and exhaust gas in the intake manifold passing through the EGR valve to the at least one cylinder, such method comprising:

determining engine operating parameters comprising: the flow to the cylinder, the flow of air through the intake throttle, and intake manifold pressure;

providing an estimate of the flow through the EGR valve from the determined engine operating parameters; and

determining an estimate of the air fraction on the exhaust gas passed through the EGR to the intake manifold; and adjusting the intake throttle in accordance with a desired partial pressure of the air in the intake manifold and the estimated flow through the EGR valve.

13. (original) A method for controlling partial air pressure in an intake manifold of an engine, such engine having an intake throttle device for controlling a flow of air to the intake manifold, an EGR valve for controlling a flow of exhaust gas from the engine to the intake manifold downstream of the intake throttle, and at least one cylinder fed a flow comprising air passing through the throttle to the intake manifold and exhaust products passing through the EGR valve to the intake manifold, both the air through the throttle and the exhaust gas products in the intake manifold passing as a combined flow to the intake manifold and then to the at least one cylinder, such method comprising:

calculating the desired partial pressure of air dynamically, as a function of time in accordance with a reference model;

estimating the flow of exhaust gas products passing through the EGR valve to the intake manifold from engine operating parameters;

estimating the air fraction in the estimated flow of exhaust gas products passing through the EGR valve to the intake manifold; determining the partial pressure of air in the intake manifold from such estimate of the flow of exhaust gas products and such estimate of the air fraction; and,

adjusting the intake throttle device in accordance with a difference between a desired partial pressure of the air in the intake manifold and the determined partial pressure of air in the intake manifold.

14. (cancelled)

15. (original) An engine control unit programmed to execute the following:

storing in a memory of such unit a specified dynamic reference model for a desired partial pressure of the air as a function of time; and

controlling a flow through an intake throttle device in accordance with an estimated exhaust gas recirculation flow obtained by a dynamic observer and an estimate of partial air fraction in exhaust gas products.

16. (original) An engine control unit programmed to execute the following:

calculate a desired partial pressure of air dynamically, as a function of time in accordance with a reference model;

estimate the flow of exhaust gas products passing through an emission gas recirculation to an intake manifold from engine operating parameters;

estimate the air fraction in the estimated flow of exhaust gas products passing through an EGR valve to the intake manifold;

determine the partial pressure of air in the intake manifold from such estimate of the flow of exhaust gas products and such estimate of the air fraction; and,

adjust the intake throttle device in accordance with a difference between a desired partial pressure of the air in the intake manifold and the determined partial pressure of air in the intake manifold.

17. (cancelled)